A New Eye Mutant, *apricot*, of the Oriental Fruit Fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae), and its Mating Preference

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ABSTRACT. Genetic crossing experiments of the apricot eye *(ap)* mutant, discovered in a recently introduced laboratory colony of *Bactrocera dorsalis* (Hendel), demonstrated that it was inherited as an autosomal recessive gene. Mating preference tests showed that both apricot eye females and wild-type females preferred to mate with males of their own strains. However, only wild-type males were highly successful in mating with both types of females.

KEY WORDS: Eye mutant, *Bactrocera dorsalis*, mating preferences.

The oriental fruit fly, *Bactrocera dorsalis* (Hendel), is one of the most destructive crop pests, since it attacks more than 120 species of fleshy fruits (Bess and Haramoto 1961). Most wild *B. dorsalis* flies possess yellow markings on the scutellum and thorax; those of another 2-4% of the natural population in Hawaii are white in color (Hart and Steiner 1972). Eye color of wild-type adults is deep purple with blue-green irridescence.

The first described eye color mutant gene, Mandarin red *(ma)*, in *B. dorsalis* is an autosomal recessive gene (McCombs and Saul 1989). Conditional lethal genes in eye pigment pathways are an important class of mutant alleles. Therefore, basic information on the genetics of other eye mutant genes is important and will contribute to the construction of a library of mutant genes. In addition, mating preference tests on mutant strains will provide further information regarding possible use of specific mutant strains as genetic markers in sterile insect release programs.

MATERIALS AND METHODS

A laboratory colony of *B. dorsalis* was newly established from larvae obtained from infested papaya collected from the Puna district on the island of Hawaii. The colony was continually maintained on papaya at 20-26°C, 65±20 %R.H., under semi-natural lighting conditions within the laboratory at the University of Hawaii, Honolulu, as described by Poramarcom (1988). The original field collected individuals had wild-type

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eyes (deep purple with blue-green irridescence) and yellow markings on the scutellum and thorax.

At the 4th generation under laboratory rearing, two males and one female with apricot colored eyes *(ap)* and white scutellum and thorax were discovered in the colony. These mutant flies were allowed to mate *inter se* for two subsequent generations to isolate a pure-breeding colony of *ap* flies. A pure-breeding colony was obtained in the 5th generation. Crosses in succeeding generations were designed to establish an inheritance mechanism for the trait. Reciprocal crosses were conducted between wild type and *ap* individuals, using twelve single pairs each, to yield F1 offspring. Further reciprocal crosses were made between wild-type F1 with *ap* parents using eight single pairs in each intercrossing, and by mass-mating to yield F2 offspring. The results were analyzed by chi-square tests.

The *ap* strain was further tested for mating preferences. Mate choice experiments were conducted for both sexes separately by placing three flies per cage in cylindrical paper cages (8 cm diam., 8 cm height). Two flies, one *ap* eye and one wild-type, of the sex being tested, were placed together with an individual of the opposite sex of either strain. A total of 28 groups of females and 45 groups of males was tested separately for each sex. Matings were recorded daily after sundown, since it has been confirmed that this species mates at dusk (Roan et al. 1954, Keiser et al. 1973, Kobayashi et al. 1978, Arakaki et al. 1984, Poramarcom 1988). The test in each cage was terminated when mating was observed or after seven days, whichever came first. The results were analyzed by a chi-square test.

TABLE 1. Progenies from various crosses involving wild-type *(w.t.)* and apricot eye mutant *(ap)* of *Bactrocera dorsalis*.

Mating combination		Number pairs	Number of progeny				chi-square	P = .05
			wild-type		apricot eye			
M	F		M	F	M	F		
1. *w.t.* × *ap*		12	294	320	0	0		
2. *ap* × *w.t.*		12	292	316	0	0		
3. *w.t.*(F1) × *ap*		8	48	47	44	45	0.19	NS
		mass	86	55	74	58	0.29	NS
4. *ap* × *w.t.*(F1)		8	74	49	66	61	0.06	NS
		mass	209	195	191	166	2.9	NS

RESULTS AND DISCUSSION

The F2 offspring ratios obtained from the monohybrid testcross did not differ significantly from 1:1 ratios of parental types by chi-square analysis. The results of these reciprocal crosses demonstrated that the apricot eye *(ap)* mutant gene is an autosomal recessive (Table 1). The *ap* homozygous genotype is fully expressed. This *ap* strain probably resulted from an independent mutation that arose on a chromosome that already carried the

whitish scutellum and thorax. This is the first morphological mutant discovered in an early generation of a newly established colony of *B. dorsalis*. Another mutant, mandarin red eye, was described after induction by a mutagen (McCombs and Saul 1989). The eye color of this *ap* strain is very close to that of the apricot eye mutant discovered in the Mediterranean fruit fly by Rossler and Koltin (1976). The latter is also governed by an autosomal recessive gene. Similar naturally occurring morphological mutations of eye color controlled by autosomal recessive genes which have been discovered in other fruit fly species include the white eye (Sharp and Chambers 1973), apricot eye *(ap)* (Rossler and Koltin 1976), brown-orange eye *(bo)* (Saul and Rossler 1984), and garnet eye *(g)* (Rossler and Rosenthal 1988) in *Ceratitis capitata* (Wiedemann), and the yellow-eye mutant in *Bactrocera cucurbitae* (Coquillett) (Kobayashi et al. 1973).

TABLE 2. Mating preferences of apricot eye mutant *(ap)* and wild-type *(w.t.)* individuals of *Bactrocera dorsalis*.

Sex tested	Strain of the sex tested	Total number tested	Number matings	Individuals mated[a]		chi-square	Prob.
				w.t.	*ap*		
Male	*w.t.*	45	40	29	11	8.1	<0.01
	ap	45	42	13	29	6.1	<0.01
Female	*w.t.*	28	26	11	15	0.62	NS
	ap	28	25	5	20	9.0	<0.01

[a]Each sample consists of two individuals, one apricot eye mutant *(ap)* and one wild-type *(w.t.)*, of the opposite sex, placed with a *w.t.* or *ap* fly of the sex being tested.

Experimental evidence of female discrimination for certain males in *B. dorsalis* has been successfully demonstrated (Poramarcom 1988). Such female preferences are based on olfactory signals, an important component of sexual selection in this species. Mate preference tests that involved mating of a single female placed in a cage with one male from each strain, indicated that both *ap* females and wild-type females preferred to mate with males of their own strains (Table 2). In mate preference tests that involved a single male placed in a cage with two females, more *ap* males mated with *ap* females than with wild-type females. These results are very similar to those of Wong et al. (1982) who demonstrated sexual isolation between laboratory-reared and wild strains of *B. dorsalis*, due to a preference for mating between members of the same strain. The only difference in my results was that wild-type males were equally accepted as mates by both wild-type and *ap* females (Table 2). However, *ap* males were significantly more often accepted as mates by *ap* females than by wild-type females. *Ap* males may attempt copulation randomly between the two kinds of females, but wild-type females were less likely to mate with them, presumably because of a lack of necessary courtship signals in *ap* males. On the other hand, wild-type males may possess all necessary attributes which satisfy most

females, both wild-type and *ap* strains. Distinctive colors or markings on the body or wings of some tephritids suggest that these may serve as visual signals (Dodson 1978, Tauber and Toschi 1965a, 1965b). However, visual stimuli apparently do not play a significant role at close range in successful mating of *B. dorsalis* (Poramarcom 1988). Therefore, the greenish or apricot eye color and the yellow or whitish thorax and scutellum of individual flies are not an apparent source of discrimination. Females are likely to discriminate among the courting males on the basis of olfactory signals, as was demonstrated in another study (Poramarcom 1988).

If this eye color could be linked to the sex chromosome and behave as a conditional lethal gene in females, the release of males-only might be facilitated. Such a genetic sexing system, which allowed the mass-release of only male flies might increase the effectiveness and acceptability of the sterile insect release method. *Ap* males released along with wild-type males probably would not be successful in competing for mates (Table 2).

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